Draft External Assessment Resources
For planning purposes only

2

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2 Physics

2.4: Demonstrate understanding of mechanics

Credits: Six

Check that you have completed ALL parts of the box at the top of this page.

Check that you have been supplied with the resource sheet for Level 2 Physics.

You should answer ALL parts of ALL questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO YOUR TEACHER AT THE END OF THE ALLOTTED TIME.

For Assessor's use only	**Achievement Criteria**	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Demonstrate understanding of mechanics. ☐	Demonstrate in-depth understanding of mechanics. ☐	Demonstrate comprehensive understanding of mechanics. ☐
Overall Level of Performance ☐		

You are advised to spend 60 minutes answering the questions in this booklet.

Assessor's use only

QUESTION ONE: MOTION

(a) Jason drops a stone vertically down from the top of a bridge into the water below. It takes 2.5 s for the stone to reach the water.

Calculate the velocity of the stone when it hits the water. Use $g = 9.8\,m\,s^{-2}$.

Velocity: _____

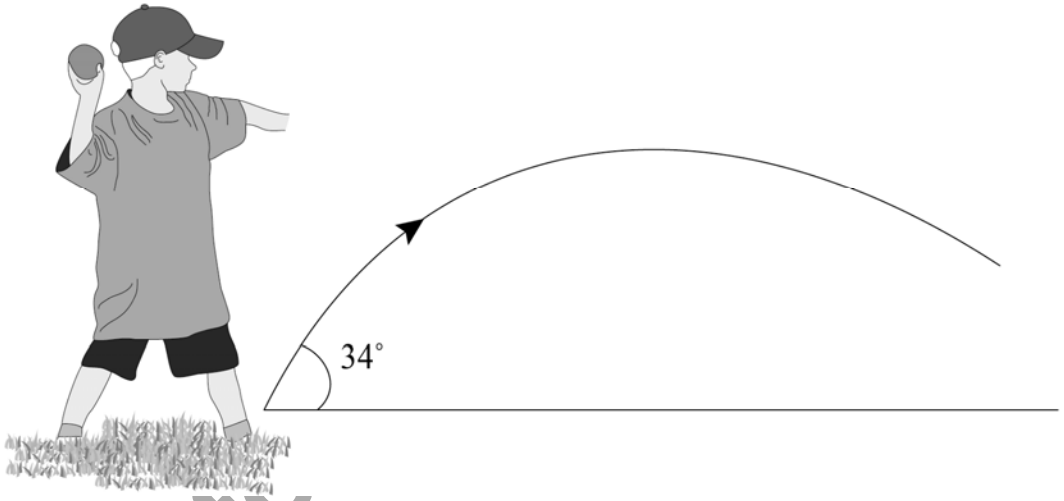
(b) Explain the forces acting on the stone as it falls towards the water below.

Assessor's use only

(c) Explain in detail how the forces that act on the stone change as it enters the water and sinks down to the bottom of the river bed. In your answer, you should include an explanation of how this would affect the motion of the stone.

(d) On another occasion, Jason throws the stone from the ground at an angle of 34° to the horizontal with a velocity of 25 m s^{-1} as shown in the diagram below.

Diagram not to scale



Determine the range by calculating:

- the velocity vector components
- the time taken to reach maximum height.

QUESTION TWO: FORCES

Assessor's use only

Jason's dad Mike drives his car at a constant speed around a horizontal circular track as shown in the diagram below.

(a) The radius of the circular track is 28.0 m. Mike drives at a constant speed. It takes 12.0 s to go around the circular track once.

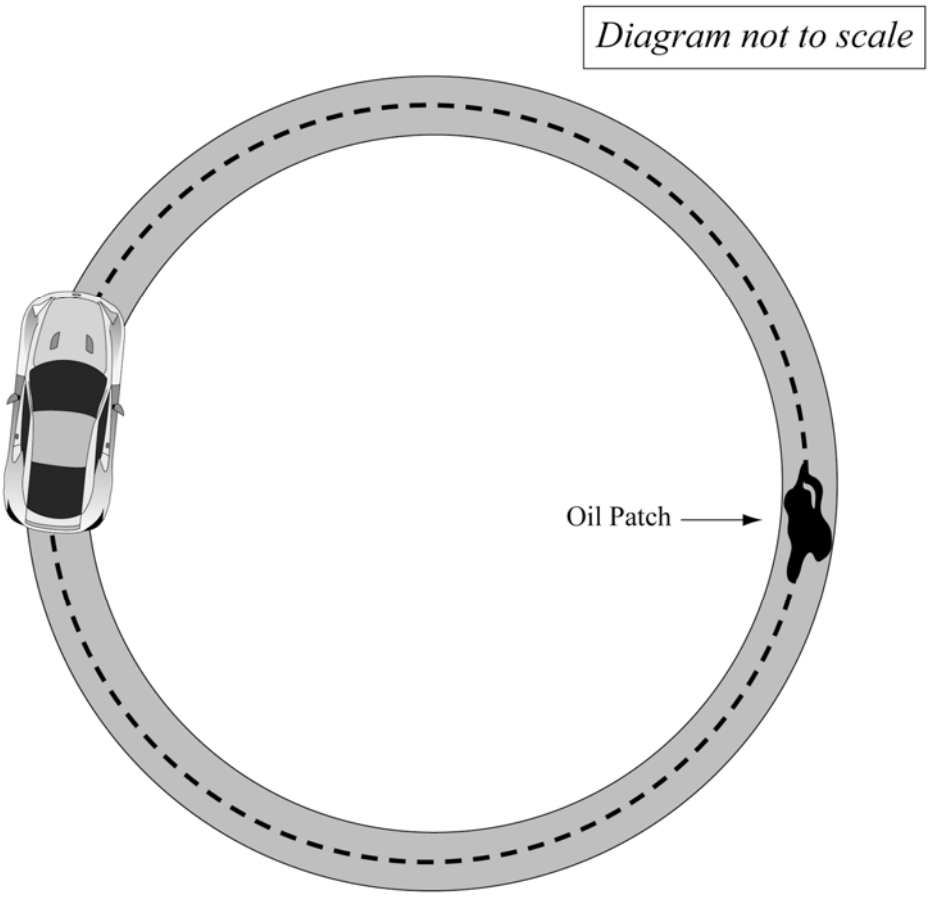
Calculate the speed and hence the acceleration of the car.

Speed of the car: _____

Acceleration of the car: _____

(b) Explain why the motion of the car would be affected if there was an oil patch on the circular path as shown in the diagram below. (Assume that the oil causes complete loss of friction between the car wheels and the surface of the track.)

Assessor's use only

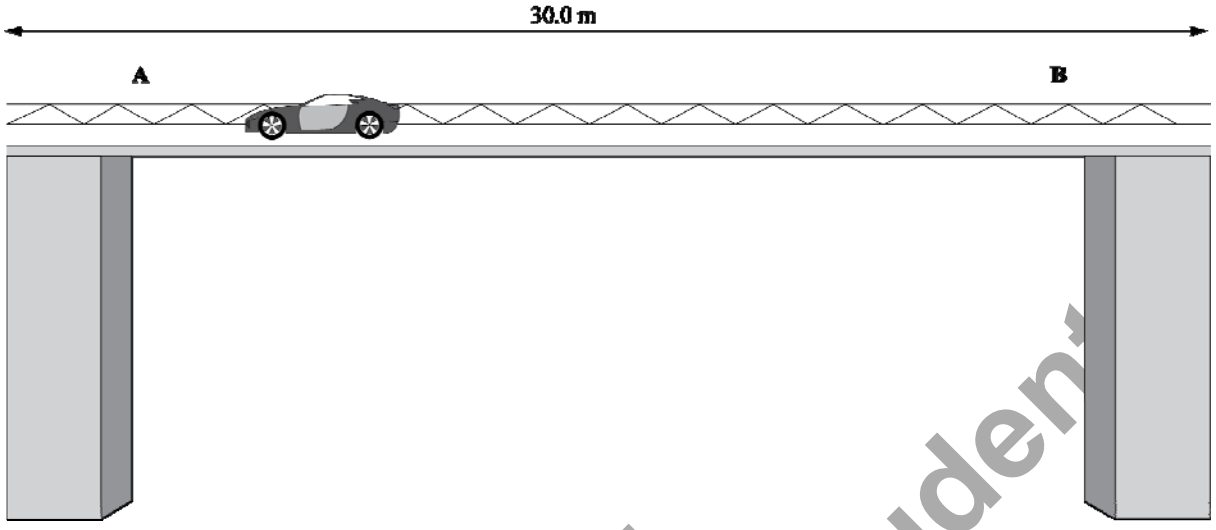


In your answer, you should include:

- an explanation of the forces acting on the car while it is moving in a circle
- an explanation of the how the motion of the car is affected once it encounters the oil patch.

Assessor's use only

(c) On another occasion, Mike drives his car over a uniform bridge. The bridge has two supports. The mass of the bridge is 5000 kg and the mass of Mike and his car is 1500 kg. The bridge is 30.0 m long. See the diagram below.



Calculate the support provided by end A and end B of the bridge when Mike and his car are at a distance of 10.0 m from end A of the bridge. In your answer, you should include arrows to show:

- the weight of the bridge and the weight of the car
- the support forces provided at the ends of the bridge.

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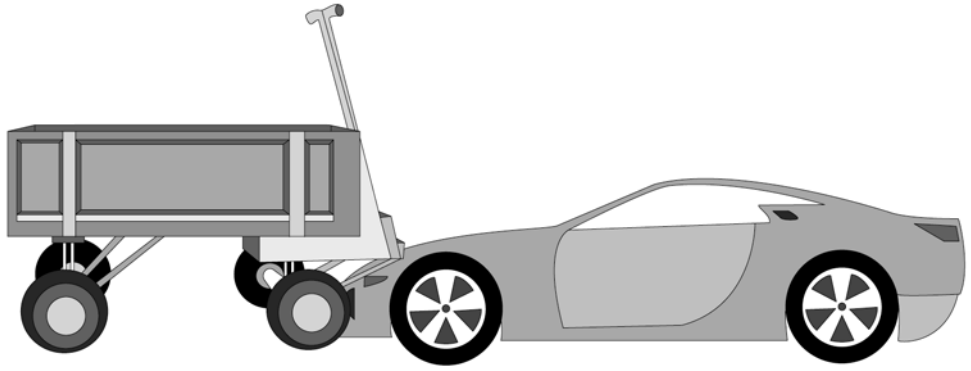
QUESTION THREE: MOMENTUM AND ENERGY

Assessor's use only

Mike's car collides with a stationary trolley as shown in the diagram below.



(a) After the collision, the car and trolley lock together and move as one.

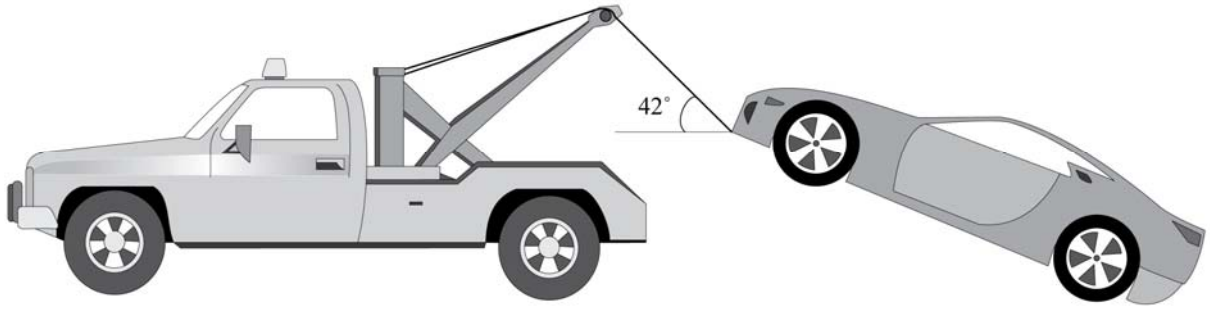
Calculate the final velocity of the car and trolley together.
Mass of Mike's car = 1500 kg
Mass of trolley = 650 kg
Initial velocity of Mike's car = 18 m s^{-1}

(b) Mike's car has a long crumple zone.

Explain in detail why having this crumple zone would make a difference during impact. In your answer, you should include ideas of velocity before and after the impact.

Assessor's use only

(c) Mike's car is towed away by a tow truck. The rope attached to the car makes an angle of 42° with the horizontal. The rope pulls the car with a force of 850 N. The car moves a distance of 45 m along the horizontal road during a time of 15 s. See diagram below.



Calculate:

(i) the work done by the tow truck on the car.

(ii) the power produced by the tow truck while it is moving the car.

(d) Suspension is the term given collectively to the springs, shock absorbers, and linkages in a car. The suspension springs on Mike's car are soft springs when compared to the suspension springs of a truck.

Explain in detail why, in terms of spring constant and extension, a truck needs to have stiffer suspension springs.

Extra paper for continuing your answers, if required.
Clearly number the question.

Assessor's use only

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